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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Denis THIOT

Application No.: **10/667327**

Filing Date: 23 September 2003

Title: GAS-COOLED GENERATOR

Art Unit: [to be assigned]

Examiner: [to be assigned]

Atty. Docket: 003-084

CLAIM FOR PRIORITY UNDER 35 U.S.C. § 119

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Priority under 35 U.S.C. § 119 is hereby claimed to the following priority document(s), filed in a foreign country within one (1) year prior to the filing of the above-referenced United States utility patent application:

Country	Priority Document Appl. No.	Filing Date
GB	0222406.1	26 September 2002

A certified copy of each listed priority document is submitted herewith. Prompt acknowledgment of this claim and submission is respectfully requested.

Respectfully submitted,

Date: 5 NOV. 2003

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10/667,722

The Patent Office

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Signed

Dated 23 September 2003

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The
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27SEP02 E751410-1 D03312
P01/7700 0.00-0222406.1

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference GBP85727

2. Patent application number (The Patent Office will fill in this part) 0222406.1

26 SEP 2002

3. Full name, address and postcode of the or of each applicant (underline all surnames)

ALSTOM (Switzerland) Ltd,
Brown Boveri Strasse 7/699/5
CH-5401 Baden
Switzerland

Patents ADP number (if you know it) 8259186005

If the applicant is a corporate body, give the country/state of its incorporation Switzerland

4. Title of the invention Gas-cooled generator

5. Name of your agent (if you have one)
"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Marks & Clerk
57 - 60 Lincolns Inn fields
London WC2A 3LS

Patents ADP number (if you know it) 18001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country	Priority application No (if you know it)	Date of filing (day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing (day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d)) Yes

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	5
Claim(s)	2
Abstract	1
Drawing(s)	5 + 5

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	1
Request for preliminary examination and search (Patents Form 9/77)	1
Request for substantive examination (Patents Form 10/77)	
Any other documents (please specify)	

11. I/We request the grant of a patent on the basis of this application.

Signature Marks & Clerk Date: 26 September 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

GB Patent Filings
0207 400 3000

Document : 821684

M&C Folio: GBP85727

B01/300-GB

GAS-COOLED GENERATOR

This invention relates to a gas-cooled generator, in particular a generator forming part of a turboset.

Generators are known which comprise a rotor and stator with a gap between them. The stator comprises a core and windings which form a winding overhang at each end of the stator. The rotor has axially extending cooling channels communicating with end portions of the rotor beyond ends of the stator core and has radially extending cooling channels communicating between the axially extending cooling channels and the said gap. The stator core has cooling ducts communicating between the said gap and a region for receiving gaseous coolant outside the stator core; the generator further comprises cooling apparatus communicating with the said receiving region.

In some known generators, the rotor, stator, and cooling apparatus are in an enclosure filled with the gaseous coolant, which is driven through the cooling apparatus by fans mounted on the ends of the rotor. From the cooling apparatus separate streams of gaseous coolant under pressure flow to the stator and to the rotor. In the stator the gaseous coolant flows radially inwards or outwards or alternately inwards and outwards.

Such generators suffer from losses due to the driving of the fans and friction of the gaseous coolant.

The present invention provides a generator comprising a rotor and stator with a gap between them, the stator comprising a core and windings which form a winding overhang at each end of the stator, wherein, when the generator is operating, gaseous coolant flows from cooling apparatus past the winding overhangs, then through cooling channels in the rotor, then into the said gap, then through cooling ducts in the stator core into a coolant receiving region, and then through the cooling apparatus.

The invention will be described further, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic axial section through a first embodiment of a generator according to the invention;

Figure 2 is a partial transverse cross-section through the stator core of the generator;

Figure 3 is a fragmentary perspective view of part of one end of the rotor of the generator;

Figure 4 is an elevation of a cooler used in the generator; and

Figure 5 is a schematic axial section through a second embodiment of the generator.

In the generator shown in Figures 1 to 4, a rotor 1 is mounted for rotation about an axis (in this example a horizontal axis), the rotor being rotated by a turbine (not shown) when the generator is operating. The rotor 1 includes a cylindrical body with axial slots containing conducting bars 15, the bent ends of which are contained in winding heads 2 at respective ends of the rotor 1. The rotor 1 is surrounded by a stator 3, with a gap 4 between them. The stator 3 includes a core 6 made up of laminated core units and provided with radial ducts 5 which extend from the gap 4 to the outer circumferential surface of the core 6 and which are delimited by radial spacers 5a.

A preferred embodiment of the generator is shown in Figure 5. Only major differences from the first embodiment will be described, and similar parts are given the same reference numerals. The rotor 1 is mounted with its axis vertical, its lower end being supported by the output shaft 17 of the turbine (not shown) below, and its upper end being supported by a magnetic bearing 18. The upper end of the rotor, above the bearing 18, is connected to an exciter 19 supported by a frame 21.

The gaseous coolant leaving the upper cooler 12 flows partly past the exciter 19 and partly past the bearing 18. Part of the flow passes through the bearing 18 to the upper winding head 2 of the rotor 1, but most of the flow is conducted over the upper winding overhangs 7 before reaching the upper winding head 2. The circulation of the gaseous coolant is indicated in general terms by the arrows in Figure 5.

By putting the maximum number of parts to be cooled in a serial arrangement the total gas flow rate can be reduced to a minimum value compatible with (a) the maximum temperatures allowed by the materials used, industry standards, and contract specifications and (b) avoiding the risk of unequal distribution of the flow through some parts of the generator, which may provoke insufficient heat transfer. Lowering the total gas flow rate can significantly reduce mechanical losses; this can be achieved by ensuring that the density and, hence, the heat capacity of the gaseous coolant are high enough to keep the temperature rise reasonable all along the cooling circuit.

The use of the rotor auto-ventilation effect, without any fan, also reduces mechanical losses.

In the embodiments described above the preferred gaseous coolant is pure helium. This gas has a very high specific heat capacity if the mean pressure in the enclosure 13 is high, for example of the order of tens of bars, typically 10 to 50 bar. Furthermore, a minimum pressure of, for example 10 to 20 bar is preferred, to keep the helium dielectric properties good enough to be compatible with conventional insulating distances Serial flow allows one to derive the greatest benefit from the use of helium.

Various modifications may be made without departing from the scope of the invention. For example, another noble gas or, indeed, any suitable gas (e.g. nitrogen) or mixture of gases (e.g. air) providing sufficient cooling and dielectric properties may be used instead of helium. The coolers 12 may be of any convenient type and may be arranged at any convenient locations in the enclosure 13 to provide sufficient cooling. Instead of the coolers 12 in the enclosure 13, one or more coolers could be arranged outside the enclosure 13 and connected to the receiving region 11 and the end regions of the enclosure by suitable conduits. Although it is not preferred, fans could be provided to assist the flow of gaseous coolant through the cooler(s). Other rotor constructions than that illustrated in Figure 3 could of course be used.

Claims:

1. A generator comprising a rotor and stator with a gap between them, the stator comprising a core and windings which form a winding overhang at each end of the stator, wherein, when the generator is operating, gaseous coolant flows from cooling apparatus past the winding overhangs, then through cooling channels in the rotor, then into the said gap, then through cooling ducts in the stator core into a coolant receiving region, and then through the cooling apparatus.

2. A generator as claimed in claim 1, including baffles for inhibiting escape of the gaseous coolant from the ends of the said gap.

3. A generator as claimed in claim 1 or 2, in which the flow of gaseous coolant is caused by the centrifugal force acting on the gaseous coolant in the cooling channels of the rotor.

4. A generator as claimed in any preceding claim, in which the rotor and stator are in a substantially hermetically sealed enclosure filled with the gaseous coolant.

5. A generator as claimed in claim 4, in which the pressure in the enclosure is superatmospheric.

6. A generator as claimed in claim 5, in which the said pressure is at least 10 bar.

7. A generator as claimed in any of claims 4 to 6, in which the cooling apparatus is within the enclosure.

8. A generator as claimed in claim 7, in which the cooling apparatus comprises at least one cooler at each end of the said receiving region.

9. A generator as claimed in any preceding claim, in which the gaseous coolant comprises a noble gas.

10. A generator as claimed in claim 9, in which the gaseous coolant comprises helium.

11. A generator as claimed in any preceding claim, in which the rotor has axially extending cooling channels communicating with end portions of the rotor beyond ends of the stator core and has radially extending cooling channels communicating between the axially extending cooling channels and the said gap.

12. A generator as claimed in any preceding claim, in which the stator core has radially extending cooling ducts, each communicating between the said gap and the receiving region outside the stator core.

13. A generator as claimed in any preceding claim, in which part of the flow from the cooling apparatus flows past a bearing for supporting the rotor.

14. A generator as claimed in any preceding claim, in which part of the flow from the cooling apparatus flows past an exciter.

15. A generator as claimed in any preceding claim, in which the rotor axis is vertical.

16. A generator substantially as described with reference to, and as shown in, Figure 1 to 4 of Figure 5 of the accompanying drawing.

ABSTRACT:

GAS-COOLED GENERATOR

Gaseous coolant, preferably helium, flows from coolers 12 past the winding overhangs 7 of the stator 3, then through cooling channels in the rotor 1, then into the rotor/stator gap 4, then through cooling ducts in the stator core 6 into a coolant receiving region 11, and then through the coolers 12. The coolant flow is preferably caused solely by the rotor auto-ventilation effect.

(Fig. 5)

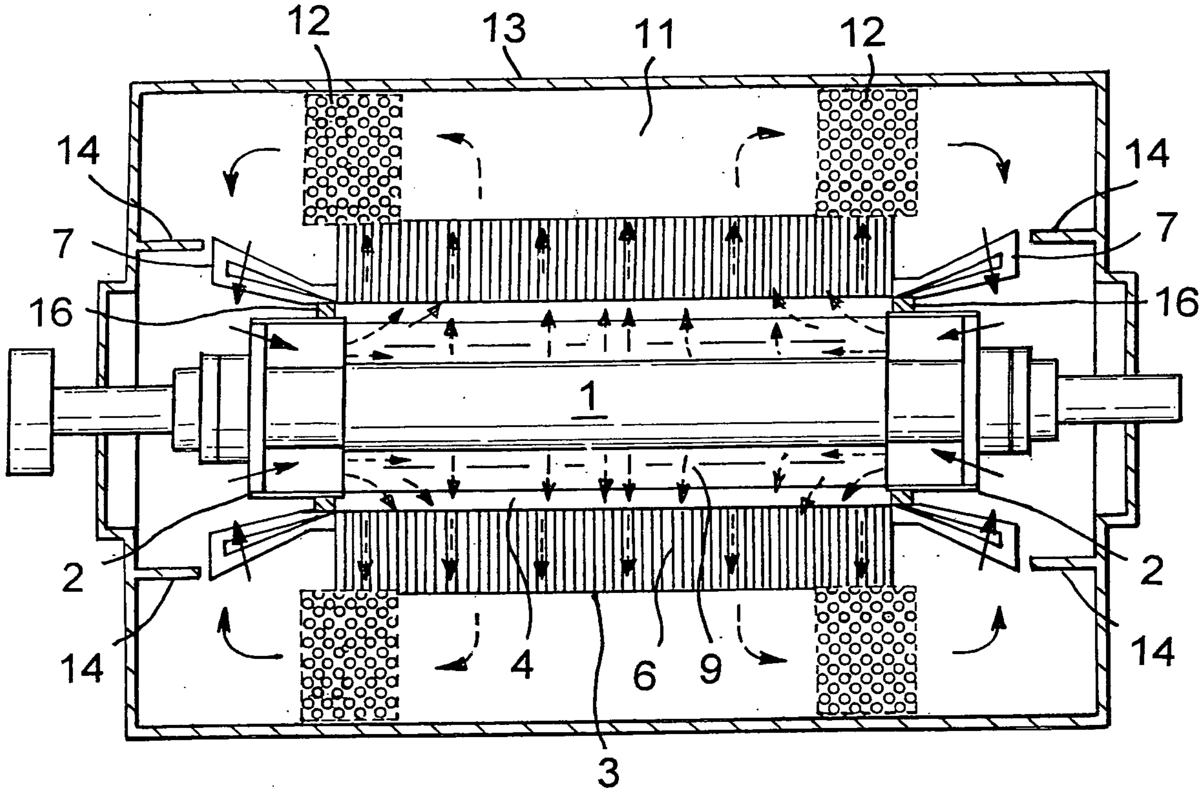

Fig.1

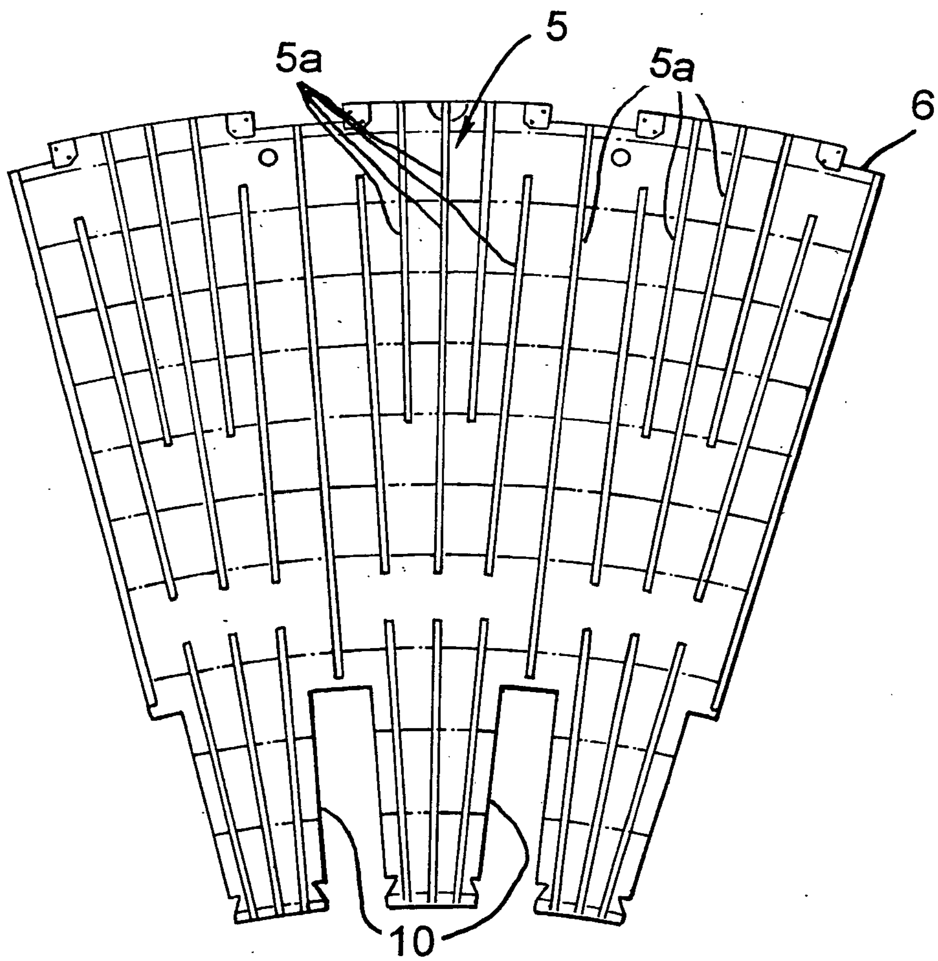

Fig.2

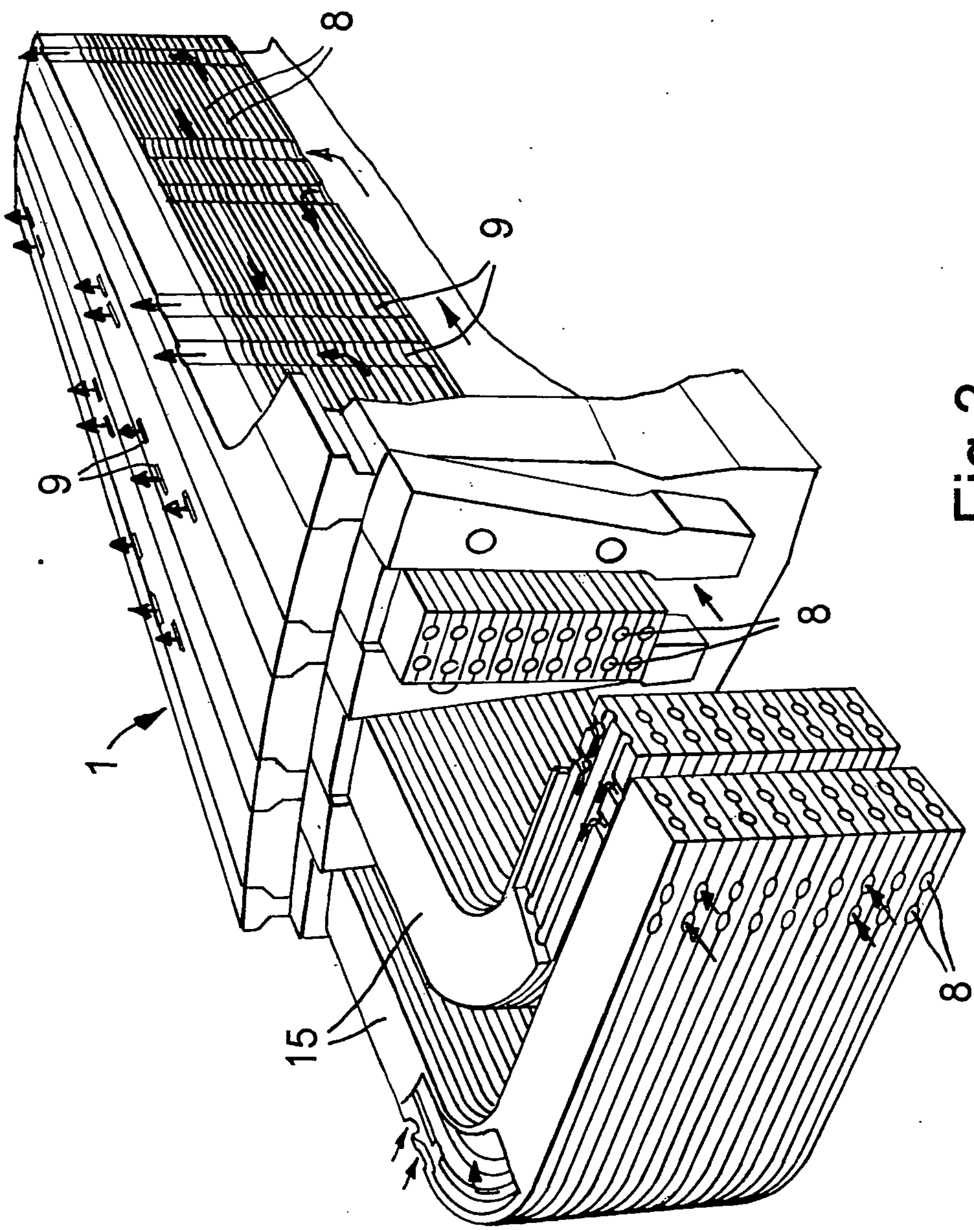

Fig.3

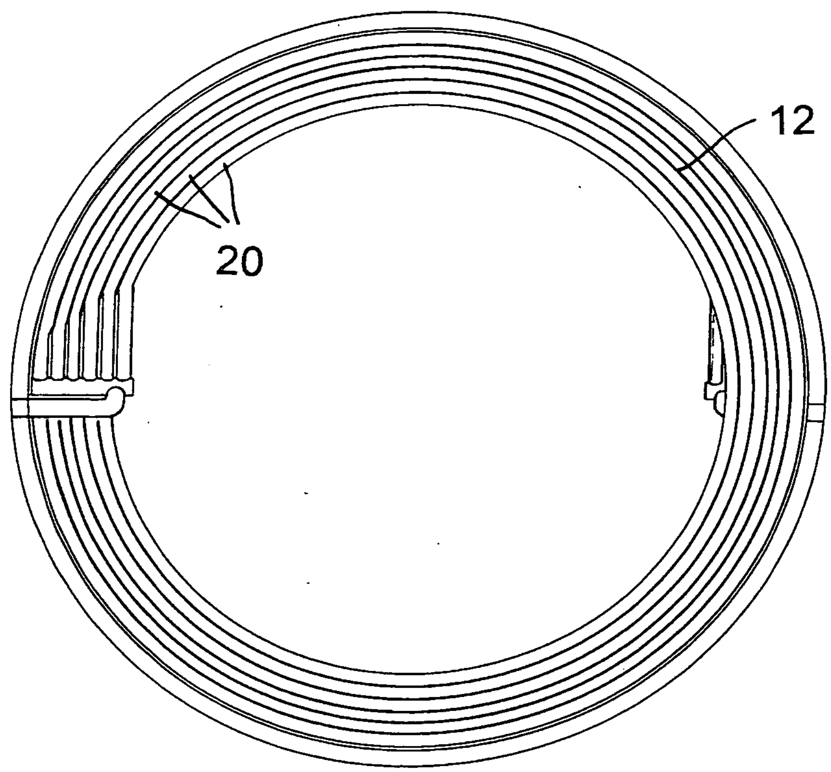

Fig.4

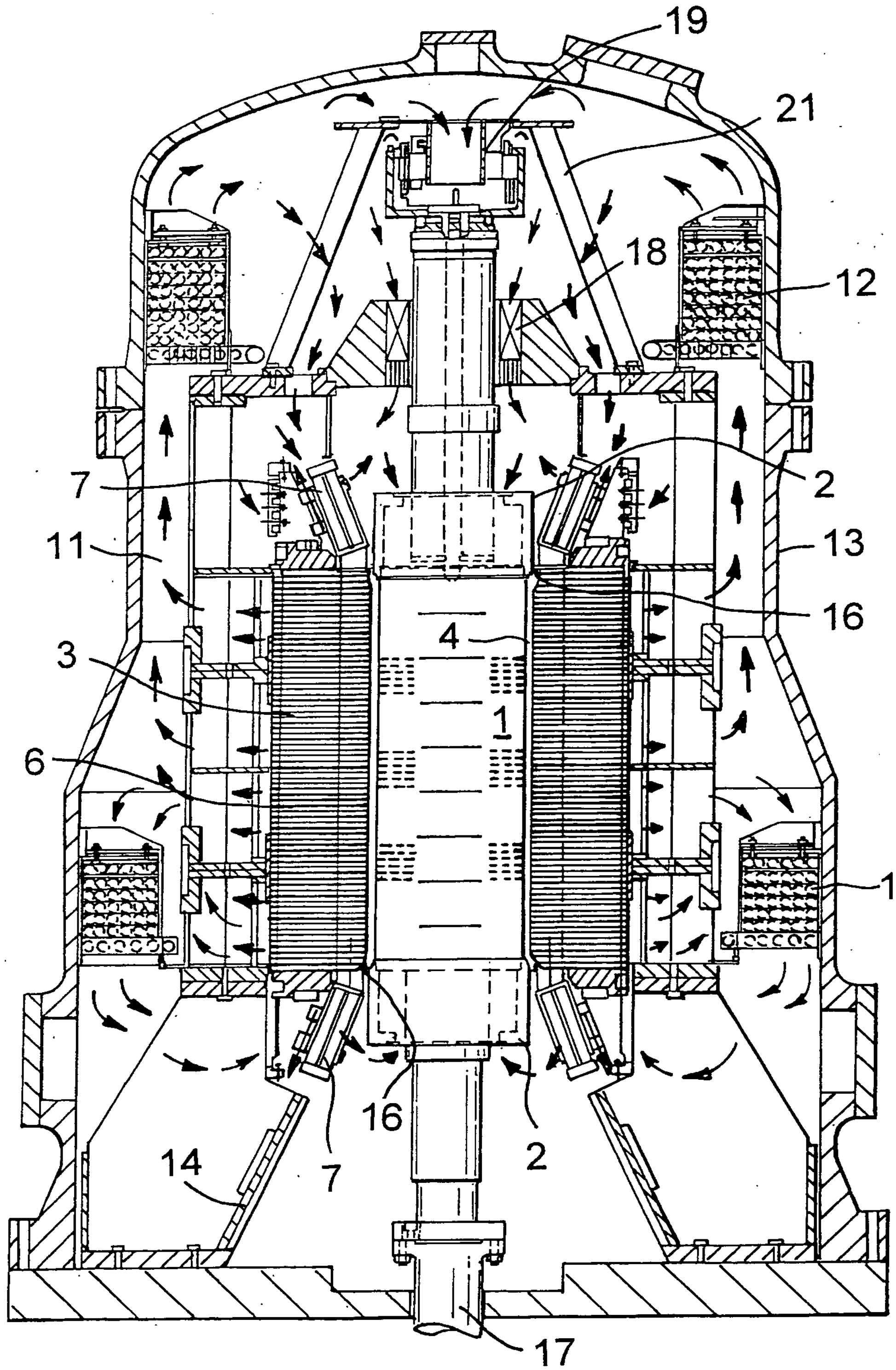

Fig.5